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Forest Pest Management Report

R-3 84-2

BIOLOGICAL EVALUATION
Effects of Soil Fumigation at
Albuquerque Tree Nursery on Soilborne
Plant Pathogens and Seedlings

Cibola National Forest
New Mexico
November 1983

ROCKY MOUNTAIN STATION

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State and Private Forestry
Forest Pest Management
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Albuquerque, New Mexico 87102

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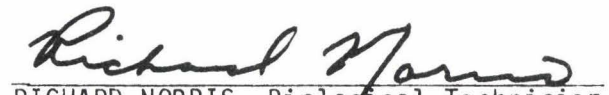

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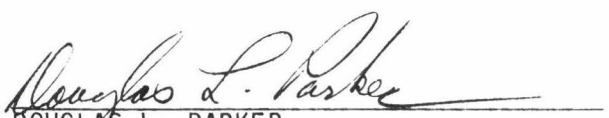

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SUMMARY

The Albuquerque Tree Nursery (ATN) annually fumigates seedbeds with methyl bromide and chloropicrin at an average rate of 350 pounds per acre for the purpose of suppressing potential soilborne plant pathogens, weeds, and nematodes. Since 1979, the Forest Pest Management Staff has evaluated the effectiveness of the annual fumigation in reducing populations of various fungi in an attempt to determine threshold population levels above which pathogenic fungi could cause unacceptable seedling losses.

Block 5 was fumigated April 25-28, 1983, using the alternate strip method. Levels of Fusarium were high before fumigation (2,952 propagules per gram (ppg)). Levels of Fusarium and Pythium were very low after fumigation. Seedling survival was significantly higher than in unfumigated plots at the end of the growing season.

In mid-June 1983, ATN suffered significant seedling losses in block 5 due to damping-off fungi. As a result, eight sections of block 1 were fumigated and prepared for sowing in July. Pre- and post-fumigation tests were conducted for Fusarium to determine populations levels.

METHODS

Prefumigation soil sampling was conducted in block 5 on April 4, 1983, specifically to test for Fusarium and Pythium. Sections 1, 3, 5, 7, and 8 through 16 of block 5, approximately 4 acres, were sampled by walking the length of each section, inserting a soil core extractor 4 to 6 inches into the soil about every 20 feet. The collected soil was mixed and placed in individual bags, labeled with the section numbers, and date of collection. The soil was treated in the laboratory using standard techniques and selective media for Fusarium and Pythium (refer to Biological Evaluation R-3 83-10). Postfumigation soil sampling was conducted on May 13, 1983, using the same techniques.

The effects of fumigation on seedling survival were determined by establishing three unfumigated plots in block 5. In the selected sections (3, 8, and 14), the fumigation crew was instructed to establish plots, each 16 by 44 feet, oriented east-west. These plots were located approximately 315 feet from the south end of the block. Wired flagging was placed at each corner of each unfumigated plot. Areas adjacent to and either north or south from the unfumigated plots served as fumigated plots.

Soil samples were taken, and estimates of seedling densities were made monthly from May through September. Soil samples were obtained from the fumigated portions of sections 3, 8, and 14, block 5, and from 8-foot wide strips centered in each unfumigated plot in the same sections, and were treated using standard techniques. Estimates of seedling density, comparing fumigated to unfumigated areas, were made by placing a 1- by 4-foot frame across each bed in the selected sections, and counting the live seedlings contained therein.

RESULTS AND DISCUSSION

Prefumigation soil sampling showed that levels of Fusarium averaged 2,952 ppg before fumigation. Block 5 was fumigated on April 25, and postfumigation levels of Fusarium averaged 67 ppg, significantly lower at the 0.01-percent level. The density of propagules had increased by the end of the growing season to approximately 585 ppg (table 1 and figure 1).

Pythium was found to be at a very low level before fumigation (averaging 2.10 ppg) and was significantly reduced by the fumigation (0.05 ppg). Because Fusarium is considered a more serious pathogen than Pythium at ATN and Pythium population levels have been consistently low, monthly tests for Pythium were not conducted. At the end of the growing season, Pythium population levels were essentially nonexistent (0.0 ppg) (table 1 and figure 2). This pattern is consistent with results reported in previous years.

In the fumigated sample plots, Fusarium levels were 133 ppg immediately after fumigation, but gradually and steadily increased to an average high of 1,067 ppg in August, then declined to 356 ppg in September (table 2 and figure 3).

In block 5's unfumigated soils, Fusarium populations were lowest in May (2,756 ppg), then steadily increased to their highest level of 3,644 ppg in September (table 2 and figure 3).

On May 23, block 5 was sown at a rate calculated to provide 50 seedlings per square foot. Initial seedling density was higher in fumigated than in unfumigated soils (28 versus 13 trees per square foot). In all probability, the low number of seedlings counted in the June sampling is due to the fact that all seeds had not germinated. The seedling count was made approximately 14 days after sowing, and, on the average, ponderosa pine seeds need 30 days to germinate.[1]

After the inital seedling count was completed on June 10, nursery personnel noticed, during visual inspections, many dead and dying trees in block 5. Surface applications of benomyl at 1 pound per acre (applied twice in a 10-day period) and captan at 10 pounds per acre were administered during the week of June 20 to control the damping-off of the seedlings in block 5. During this period, because of the losses, an unscheduled midseason sample was taken over the entire sown area of block 5. Levels of Fusarium were found to have risen from the postfumigation level of 67 ppg to 420 ppg in July (table 1 and figure 1). The soils were also tested for Rhizoctonia solani on June 28 and 29 and results were negative. At the end of the growing season, block

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[1] Agriculture Handbook No. 450, Seeds of Woody Plants in the United States.

5 had an average of 26 trees per square foot in the fumigated plots, a loss of approximately 15 trees per square foot from a high count of 41 trees per square foot in July, and 4 trees per square foot in the unfumigated plots (table 3 and figure 4).

In order to recover the losses in block 5, sections 9 through 16 of block 1 were fumigated and prepared for sowing in July. Sampling showed that levels of Fusarium were extremely high prior to fumigation in block 1, averaging 6,033 ppg. After fumigation, the levels were significantly reduced to 133 ppg (table 4).

CONCLUSIONS AND RECOMMENDATIONS

The benefits gained from fumigation of block 5, namely higher seedling survival rate, more than justify the expense of fumigation (refer to Biological Evaluation R-3 83-10).

It is recommended that fumigation be done prior to sowing in 1984.

TABLE 1.--Means and standard errors of *Fusarium* and *Pythium* populations (block 5, all sections)

	Fusarium		Pythium	
	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$
Prefumigation	2,952.38	398.01	2.10	.61
Postfumigation	66.67	23.18	0.05	0.05
Midseason	420.51	141.50		
End of season	584.61	139.03	0	0

TABLE 2.--Means and standard errors of monthly populations of *Fusarium* spp. (block 5, sections 3, 8, 14)

		$\bar{x}$	$s_{\bar{x}}$
May	Unfumigated	2,755.56	44.44
	Fumigated	133.33	76.98
June	Unfumigated	3,288.89	88.89
	Fumigated	311.11	193.73
July	Unfumigated	3,200.00	504.79
	Fumigated	800.00	538.86
August	Unfumigated	3,422.22	790.06
	Fumigated	1,066.67	461.88
September	Unfumigated	3,644.45	437.73
	Fumigated	355.56	117.59

TABLE 3.--Means and standard errors of monthly tree densities (trees per square foot) (block 5, sections 3, 8, 14)

		$\bar{x}$	$s\bar{x}$
June	Unfumigated	13	1
	Fumigated	28	5.21
July	Unfumigated	6	0.58
	Fumigated	41	5.46
August	Unfumigated	5	0.58
	Fumigated	31	5.70
September	Unfumigated	4	0.38
	Fumigated	26	2.38

TABLE 4.--Means and standard errors of Fusarium populations (block 1)

	$\bar{x}$	$s\bar{x}$
Prefumigation	6,033.33	1,533.07
Postfumigation	133.33	100.79

FIGURE 1.-- MEAN POPULATIONS OF FUSARIUM AT THE ALBUQUERQUE TREE NURSERY

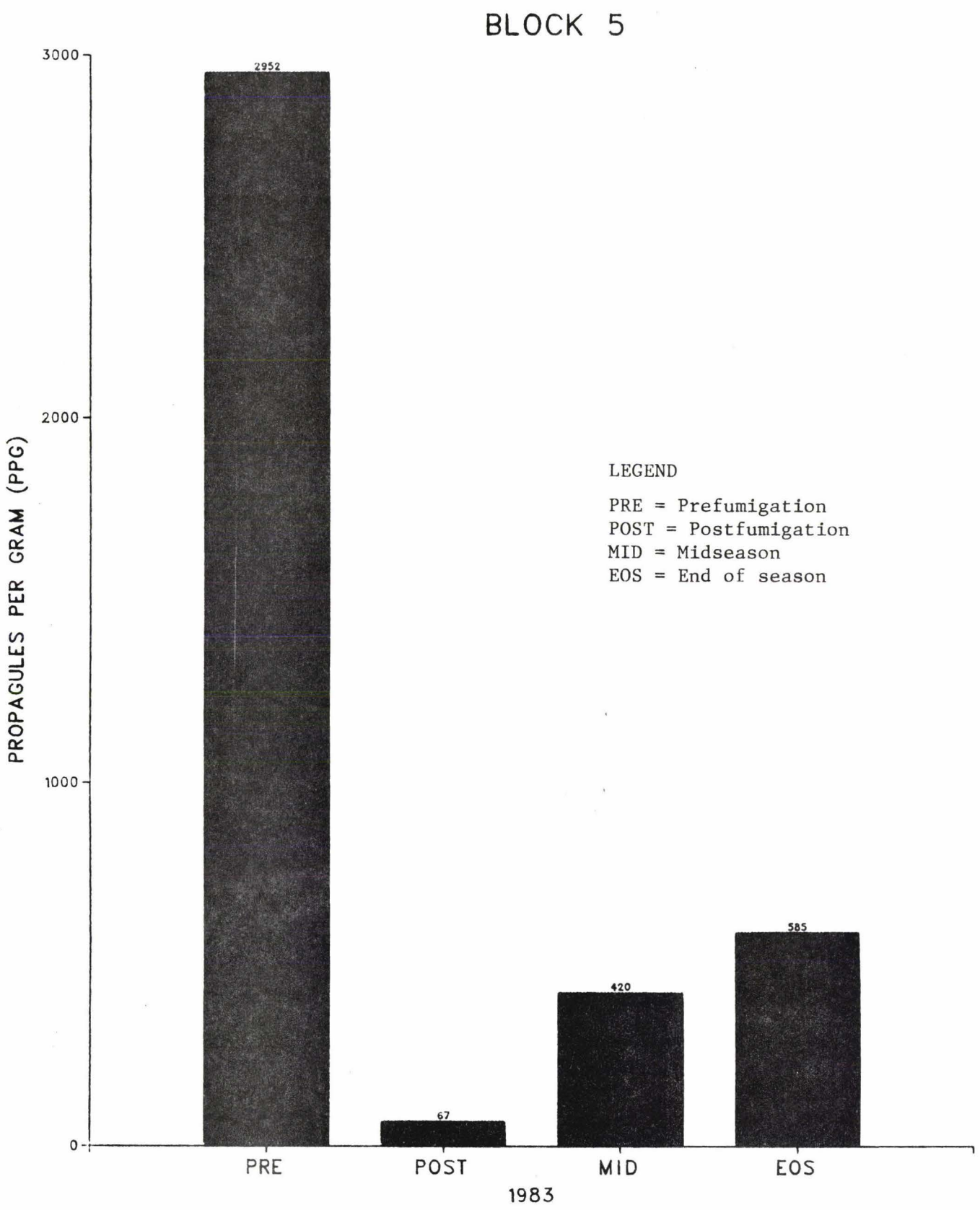

FIGURE 2.--MEAN POPULATIONS OF PYTHIUM AT THE ALBUQUERQUE TREE NURSERY

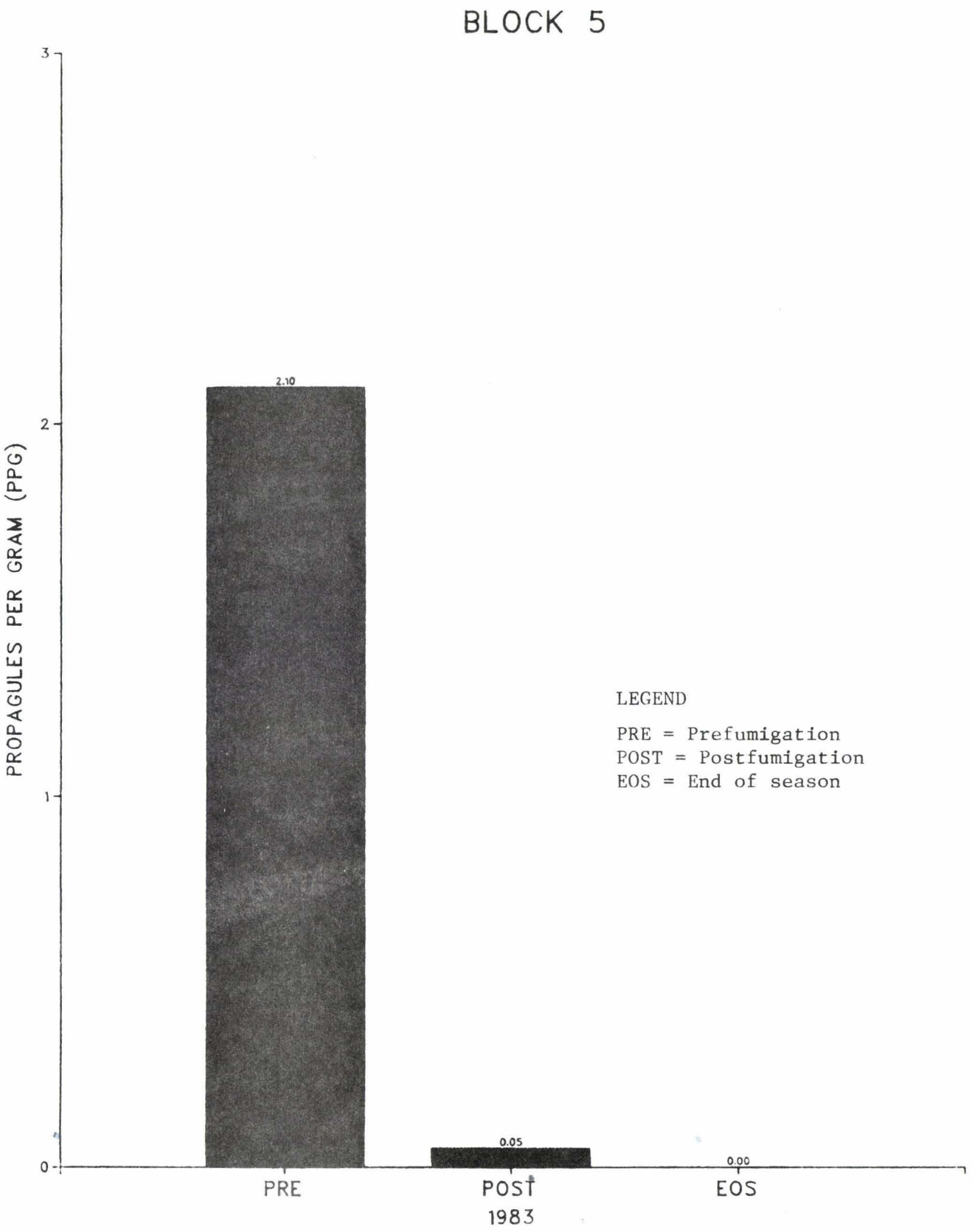

FIGURE 3.-- MEAN MONTHLY POPULATIONS OF FUSARIUM SPP. AT THE ALBUQUERQUE TREE NURSERY

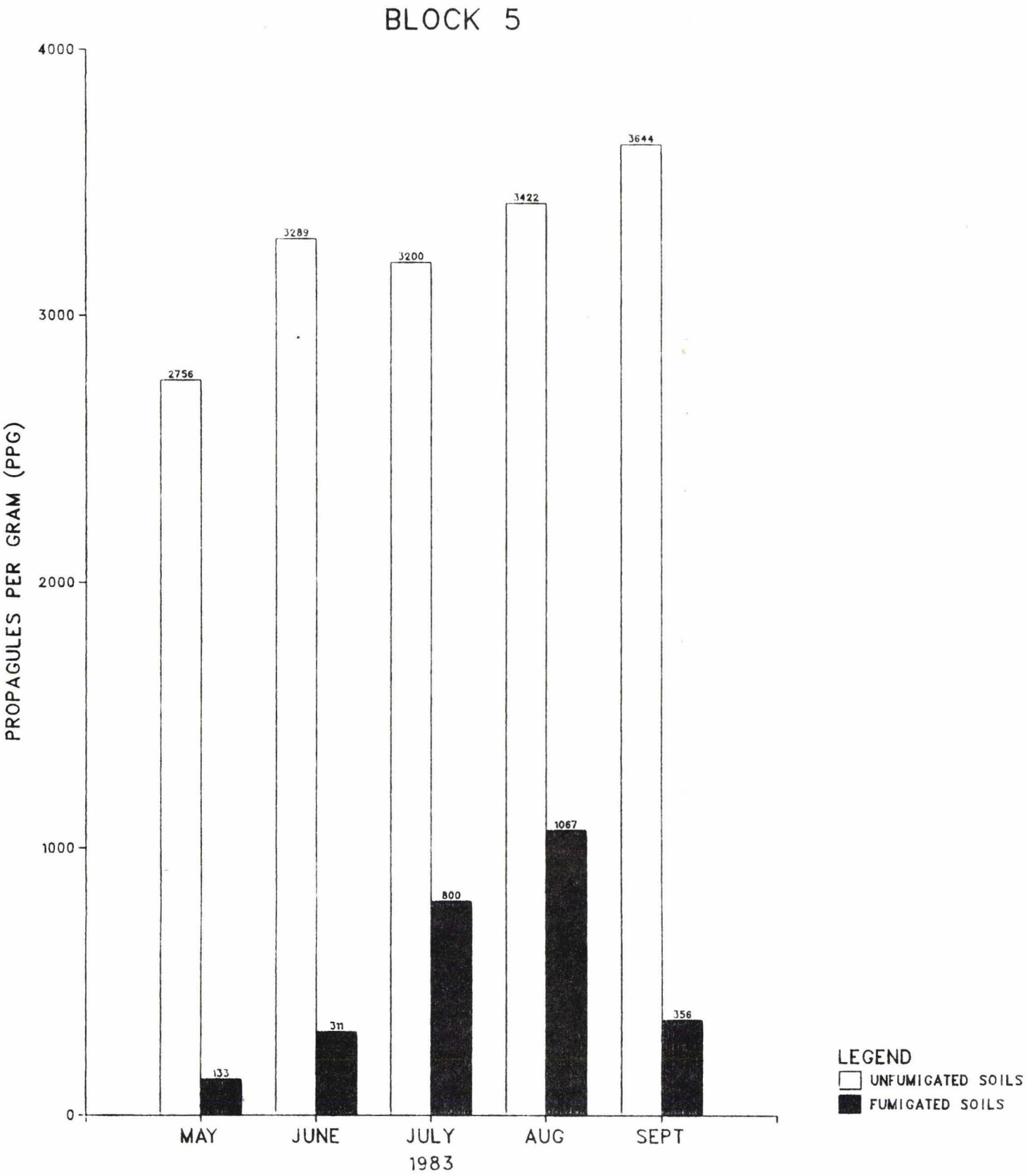

FIGURE 4.-- MEAN MONTHLY TREE DENSITIES
AT THE ALBUQUERQUE TREE NURSERY